ADDITION OF SENSORY POLLUTION LOADS FOR THE CALCULATION OF REQUIRED VENTILATION RATES

Pawel Wargocki and P. Ole Fanger

International Centre for Indoor Environment and Energy
Technical University of Denmark

Five controlled field and laboratory experiments on addition of sensory pollution loads were carried out. Three of these experiments were carried out using untrained panels (as prescribed in Appendix C of ASHRAE Standard 62 (1989)) assessing the quality of air polluted by building materials, people and tobacco smoke (Lauridsen et al., 1988; Iwashita et al., 1989; Wargocki et al., 1996), whereas two experiments were made using trained panels assessing the air polluted by mixtures of different building materials (Bluyssen and Fanger, 1991; Bluyssen and Cornelissen, 1997). The former experiments were full-scale - subjects entered a chamber for assessments or assessed the air extracted from an ordinary office space. The latter experiments were small-scale - the subjects assessed the air extracted from 3-litre glass jars where the materials were placed.

For determining required ventilation rates, it is particularly relevant whether sensory pollution loads from three large groups or "families" of pollutants – human bioeffluents, building pollutants (including HVAC system pollutants) and in some cases environmental tobacco smoke – when present at the same time in a space, can be added to predict the total sensory pollution load. Three full-scale experiments studied such families of pollutants and their results, shown in Figure 1, confirm that addition of sources is a reasonable approximation for estimating the total sensory pollution load on the air. In a binomial test, predicted total sensory pollution loads were not significantly different from the measured total loads (N=25, Z_o=1.2, P<0.12).

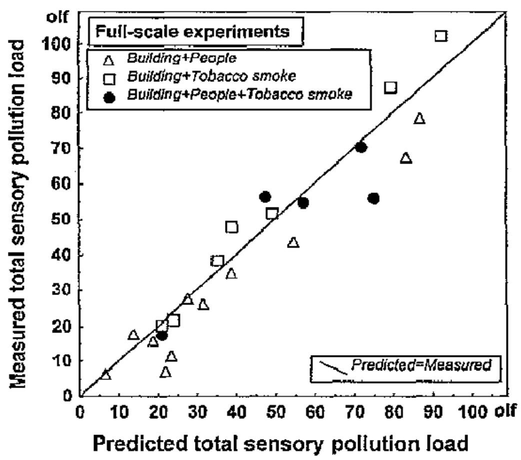

Fig. 1 Total sensory pollution loads predicted by adding sensory loads on the air caused by the building (building materials, furnishings, HVAC system), people and tobacco smoke compared with the measured total sensory pollution load. Data from controlled full-scale laboratory and field studies using untrained subjects to assess the perceived air quality (Lauridsen et al., 1988; Iwashita et al., 1989; Wargocki et al., 1996)

The results of small-scale experiments where mixtures of different building materials were placed in the same 3 L ventilated jar are shown in Figure 2. While the study of Bluyssen and Fanger (1991) showed good agreement with simple addition of sources, the later study of Bluyssen and Cornelissen (1997) showed a lower combined load than addition predicts. The reason for the latter results is most likely sorption. In all binary mixtures studied by Bluyssen and Cornelissen (1997) at least one of the materials was fleecy (carpet, mineral wool, textile) with a strong ability of sorption. The fleecy material adsorbs probably some of the pollutants emitted by the other material and the total load is therefore in this case lower than predicted by simple addition. It should be noted that sorption should not be taken into account as a negative pollution load. Sorption is a different, transient phenomenon that in real spaces should be modelled in a different way than by combining sensory loads.

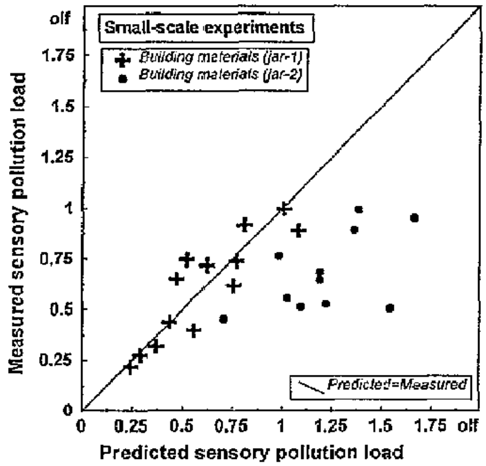

Fig. 2 Total sensory pollution loads predicted by adding sensory loads on the air caused by different building materials compared with the measured total sensory pollution load. Data from laboratory small scale experiments in which materials were placed in the same 3 L glass jar (jar-1: Bluyssen and Fanger, 1991; jar-2: Bluyssen and Cornelissen, 1997)

Conclusions

- Sensory pollution loads from people, building and tobacco smoking (if that occurs) can as a reasonable approximation be added to estimate the total sensory load.
- This means that the ventilation rate required to provide a certain perceived indoor air quality can with reasonable approximation b. found by adding the ventilation rates required to handle the building, the people and their tobacco smoking (if that occurs).

References

ASHRAE Standard 62-1989 (1989) *Ventilation for acceptable indoor air quality*, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, USA.

Bluyssen, P.M. and Fanger, P.O. (1991) "Addition of olfs from different pollution sources determined by a trained panel", *Indoor Air*, 2(4), 417-421.

Bluyssen, P.M. and Cornelissen, H.J.M (1997) "Addition of sensory pollution loads - simple or not?", In: *Proceedings of Healthy Buildings/IAQ '97*, Washington DC, USA, Virginia

Polytechnic Institute and State University, Vol. 2, 213-218.

Iwashita, G., Kimura, K., Dol, S., Sato, T. and Otaki T. (1989) "Pilot study on addition of olf units for perceived air pollution sources", In: *Proceedings of Annual SHASE Meeting*, Sapporo, Japan, 321-324, (in Japanese). (see also Iwashita, G. and Kimura, K. (1995) "Addition of olfs from common air pollution sources measured with Japanese subjects", Presented at: *CIB Working Group WG77: Indoor Climate*, Milan, Conseil International de Bâtiment.)

Lauridsen, J., Pejtersen, J., Mitric, M., Clausen G. and Fanger, P.O. (1988) "Addition of olfs for common indoor pollution sources", In: *Proceedings of Healthy Buildings '88*, Stockholm, Sweden, Swedish Council for Building Research, Vol. 3, 189-195.

Wargocki, P., Clausen, G and Fanger, P.O. (1996) "Field study on addition of indoor air sensory pollution sources", In: *Proceedings of Indoor Air '96, The 7th International Conference on Indoor Air Quality and Climate*, Nagoya, Japan, Institute of Public Health, Vol. 4, 307-312.